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GEOTECHNICAL STUDY REPORT

Tertiary Treatment Plant Upgrade Project
Sonoma Valley County Sanitation District
Sonoma County, California

Sonoma County Valley Sanitation District
Owner

HDR Engineering, Inc.
Design Engineers

1P2/500/258
38122-C2:004N:188W

February, 2001

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Sonoma Valley County Sanitation District
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1P2/500/258

INTRODUCTION

A limited study of subsurface materials and conditions has been completed for the above project in accordance with the agreement between HDR Engineering, design engineers for this project, and Taber Consultants. The purpose of this study is to provide soils criteria for use in design of proposed plant upgrades: a proposed pulse bed filter complex, filter feed pump station, control building, and alum storage facility. Providing geotechnical criteria for other aspects of the project (site pavement, pipelines, etc.) is not included in the scope of this study. Other limitations of this study are discussed in the attached "General Conditions."

SITE AND PROJECT DESCRIPTION

The Sonoma Valley County Sanitation District's treatment plant is located in the Schellville area of Sonoma County, on the west side of 8th Street East, about 0.4 miles north of Highway 12. The existing facility includes several ponds, an administration building, clarifiers, chlorine contact basins, and numerous other structures. The site of this study is located at the north edge of the treatment plant property, immediately west of the chlorine contact basins. Access to the site is via an existing paved drive that extends along the south side and part of the east side of the project site.

The study site is shown on a preliminary (undated) plan by HDR Engineering, Inc. as irregularly shaped and about ½-acre in area. The site is a low knoll, with the essentially flat central area about 2-3 feet higher than vineyard land on adjoining property to the north and west, and about 4-5 feet higher than the paved drive to the east and south. Slopes are very gentle, 5:1 (H:V) or less, except along the east side of the site where the slope down to the adjacent drive has a gradient of about 2:1 (H:V) and is up to 4± feet high. No structures existed on the site at the time of our site exploration, but the possible presence of sub-surface structures or remnants of previously existing structures cannot be precluded. Vegetation on the site is limited to scattered weeds.

The existing site topographic conditions suggest the site has been graded. In a telephone conversation in December 2000, Oscar Martin of the Sonoma County Water Agency, after conferring with treatment plant personnel, indicated that: 1) the site has been used for disposal of excess soil from previous construction at the site; 2) original grades are unknown; and 3) specific compaction effort or compaction testing of the existing fill is unknown.

Proposed project elements for our study are shown on preliminary (undated) plan, section and detail drawings (labeled as sheet No.'s SP-1, -2, -4 , -5, -6, -10, -12, and –13) by HDR Engineering, Inc. Project elements include a filter complex, filter feed pumping station, control building, and alum storage facility.

Pulse Bed Filter Complex

The filter complex is shown to be 56 ft by 92 ft, including a mudwell along the east side of the structure and pipe gallery vault along the east side, and is located approximately 40 ft west of the existing chlorine contact basins. It is our understanding that the bottom of base slabs are at elevations of about 25 feet for the filter beds, 17½ feet for the mudwell, and 20¼ feet for the pipe vault. Below the filtrate gullet, the bottom of slab deepens to about elev. 23½ feet and below the pipe vault the slab deepens to encase the effluent header at a minimum elev. of about 14¾. Finish grade adjacent to the structure is expected at elev. 27 feet and the top of the influent channels is expected at 34½ feet elev.

It is our understanding the base slabs will be reinforced concrete mats (or "structural" slabs) expected to effectively distribute imposed loads across the base of slab area; average incremental soil pressure (dead plus live load) is understood to be 500 psf, or less.

Filter Feed Pumping Station

The pump station is to be approximately 18 feet wide by 25 feet long. The bottom of base slab is indicated at about elev. 10 feet and adjacent grade at elev. 25 feet. Maximum operating water surface within the pump station is indicated at elev. 20.5 feet. The pump station is expected to be supported on a reinforced structural slab and loads are anticipated to be approximately equally distributed across the base contact area. Imposed soil loads of less than 1000 psf are implied, indicating average net post-construction loads, not including buoyant effects, less than existing soil loads.

Control Building

The building is to be 31½± feet long by 25½± feet wide, located approximately 20 feet south of the filter complex, with a slab-on-grade floor and masonry walls. Wall loads of 1,500 plf or less are implied. The building foundation is indicated to be an

18 inch deep by 18 inch wide continuous reinforced concrete footing. The top of slab elevation is expected to be about elev. 26 feet.

Alum Storage Facility

The alum storage facility, located immediately west of the control building, will consist of two 10 foot diameter by 13 foot tall (6,000 gallon) storage tanks contained within an 18 foot by 32 foot slab with approximately 3 foot high perimeter walls. Slabs supporting the tanks are expected to be concrete mats (or "structural" slabs) that will effectively distribute imposed loads across the base of slab area; average incremental soil pressure (dead plus live load) of 1,000 psf, or less is implied. The top of slab is indicated at about adjacent grade elevation, expected to be about elev. 26-27. A 3 foot square by 2½ foot deep sump will be located at the edge of the slab.

REFERENCE INFORMATION

The existing facility is the subject of the following reports/letters previously prepared by this office:

- "Subsurface Investigation, Secondary Clarifier Upgrade Project" (1P2/589/63), report dated October 1, 1998.
- "Subsurface Investigation, Project Unit II – Waste Water Treatment and Equalization Facilities" (577/38), report dated September 29, 1977.
- "Foundation Investigation, Sewage Treatment Facilities" (35161F), report dated January 5, 1966.

Pertinent information from these studies was used in the preparation of this report.

STUDY PROCEDURES

Office study for this project included review of published geologic mapping and literature, and available file data (including previous site studies). Information on the nature and distribution of subsurface materials and conditions was obtained by means of two augered and sampled test borings to depths of 21½ and 31 feet below existing ground surface (to about elev. -1 and 8½, respectively) and two dynamic cone penetrometer probes.

Samples were recovered from the borings by means of 2.0-inch OD "standard penetration" (ASTM D1586) and 2.5-inch ID "split-spoon" samplers advanced with standard 350 ft-lb striking force to provide a field measure of soils consistency. Sampler penetration resistance is recorded and can be correlated to soils strength and bearing characteristics. The dynamic cone probe was also advanced with 350 ft-lb striking force and penetration resistance during driving was observed and recorded. Portions of earth materials recovered with the drive samplers were retained in moisture-proof containers for laboratory testing and reference. A bulk sample of soil cuttings was recovered from the 0-5 foot interval in Boring No. 1.

The borings were logged and earth materials field-classified by an engineering geologist as to consistency, color, texture, gradation, etc. on the bases of penetration resistance, examination of samples and observation of drill cuttings. Groundwater observations were made in the borings during drilling and after completion. Upon completion of field operations, the borings were backfilled with grout.

Laboratory tests performed on the samples to supplement field evaluation included moisture content-dry density, Expansion Index, compaction characteristics, and unconfined compressive and direct shear strength tests.

Boring locations are referenced to existing site features; elevations are referenced to elevation contours shown on the site plan provided by HDR. Locations, details of borings and results of tests are shown on Figures 1-3, attached. Alan Krause was field engineering geologist for this study.

Previous site exploration included one augered boring (No. 3, dated 1973) in the area of the southeast corner of the site; the specific location could not be determined due to differences in the available location maps. A copy of this log is attached as Figure 4.

GEOLOGIC SETTING

Published geologic mapping shows the project area to be directly underlain by Quaternary alluvial fan deposits. No faults crossing the site are shown on published mapping. The closest active fault, the Rogers Creek fault, is located approximately 3 miles to the west. This fault is indicated to have a "Maximum Moment Magnitude" of 7.0 (per Table-1, "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada," UBC-97). The site is not within an Alquist-Priolo "Earthquake Fault Zone" for fault rupture hazard.

EARTH MATERIALS

Earth materials encountered in the borings performed for this and the previous studies are consistent with the published mapping as described above. These materials are divided into three general units considered significant to the proposed project.

The surficial unit is described as stiff sandy, gravely clay and is interpreted as fill. This unit was penetrated to 4½±ft depth in B-1 and to 8±ft depth in B-2; similar fill depths are interpreted from the cone probes. Based on the lack of documentation of engineering control and boring encounters, this unit is variable in materials and consistency and should be considered unsuitable for support of structures or fill. Laboratory testing indicates an Expansion Index of 43 for a sample of this material.

Underlying the fill in both auger borings for this study, and encountered from the ground surface in the boring from 1973, are layers of compact to dense silty sand, sandy silt, sandy gravel, clayey sand and, below elev. 12-14, very stiff to hard clay. These materials are interpreted as alluvial fan deposits. The soil cuttings and samples from the borings were visually classified as varying from low to medium expansive potential. No loose native soil (topsoil), vegetation, or other deleterious materials were encountered in the borings, but their possible presence at pre-existing ground surface cannot be precluded at other locations.

During drilling for this study (December 2000) free groundwater was encountered at 28±ft deep (elev. 2±) in Boring No. 1; free groundwater was not encountered in Boring No. 2. Borings performed in the vicinity for previous studies at the treatment plant indicate groundwater at about elevation 11-13 feet in June 1998 and Boring No. 3 drilled in May 1973 had groundwater measured at about elev. 10 during drilling and at about elev. 14 three weeks later.

Free groundwater levels higher than those encountered in the 1973 boring would not be unexpected during the wet season and/or wetter years. Our records indicate that a design groundwater surface at elev. 18 has been used for design of previous treatment plant structures. Granular layers, such as encountered in Boring No. 1 at 9½ to 12 feet, might accumulate water during the rainy season (i.e. "perched" water zones) and would be expected to yield water freely. Seepage from saturated layers with substantial silt and/or clay would be expected to be minor.

SITE SEISMIC CONDITIONS

No evidence of faulting was observed at this site and the potential for ground rupture due to faulting at the site is considered very low. However, the site is within an area of high seismic exposure and strong ground shaking can be expected over the life of the proposed facility. In accordance with Chapter 16 of the Uniform Building Code (1997), this site is assigned the following:

- Seismic Zone 4 (Figure 16-2, UBC-97)
- Seismic Source Type A (Table 16-U, UBC-97)
- Soil Profile Type = S_D (Table 16-J, UBC-97)
- Near Source Factor, N_a = 1.2 (per Table 16-S, UBC-97)
- Near Source Factor, N_v = 1.6 (per Table 16-T, UBC-97)
- Seismic Response Coefficient, C_a = 0.44 N_a (Table 16-Q, UBC-97)
- Seismic Response Coefficient, C_v = 0.64 N_v (Table 16-R, UBC-97)

Liquefaction is a secondary effect associated with seismic loading. Some granular soils in the upper native soils unit might fall within the range of gradation of materials potentially susceptible to liquefaction during seismic events but the risk of liquefaction is considered low based on the relatively dense nature of these soils.

CONCLUSIONS AND DISCUSSION

The site is considered adequately stable with structure support available for proposed development. The presence of undocumented fill soil and the potential for encountering groundwater in deeper excavations are the primary geotechnical considerations for design and construction of the proposed improvements. Measures to mitigate the potential effects of these conditions are included in the recommendations herein.

Undocumented fill may extend below foundation subgrade elevation of the control building and alum storage facility, and portions of the filter complex; excavation for the pump station is expected to extend fully through the fill. The undocumented fill is considered variable in materials and consistency and is not considered suitable for support of engineered fill or structure loads. No loose native soil (topsoil), vegetation, or other deleterious materials were encountered in the borings, but their possible presence cannot be precluded and, if encountered during construction, would require treatment. Native soils underlying the existing fills are considered compact to dense and suitable for support of engineered fills and direct support of light to moderately foundation loads.

The filter complex and pump station are expected to be founded on below-grade structural slabs bearing primarily on a thin layer of aggregate fill (working pad) overlying intact native soils. The filter complex slabs will be at varying levels. Locally, depending upon actual fill depths, engineered fill might be necessary beneath some portions of the filtrate gullet and/or filter bed base slabs after removal of existing undocumented fill. The at-grade control building and alum storage facility are anticipated to be supported, respectively, by means of a continuous reinforced-concrete footing and a structural slab foundation, each established within an engineered fill prism. All engineered fill is to be founded on intact native soil after removal of undocumented fill.

The existing undocumented fill, cleaned of any vegetation, debris or other deleterious material (if any), and underlying native soils are expected to be suitable for reprocessing as engineered fill.

The "low" to "medium" expansion potential of fill materials and underlying native soils is not expected to be a significant design consideration for construction as proposed.

For below-grade structures (filter complex and pump station), consideration will be required for construction-term excavation support/slopes, subgrade preparation, structure loading/settlements and the potential for differential settlements between structure segments with varying support levels (e.g. between filter beds and mudwell). Structure buoyancy is not expected to be a significant design consideration.

Excavation is expected to be readily achieved using standard heavy-duty grading equipment. Proposed excavations, if performed in the dry season, are not expected to encounter groundwater, although the possibility cannot be ruled out. Excavations penetrating below groundwater level are expected to encounter seepage, heavier in local more granular zones, but such seepage is expected to be controllable by pumping.

For consideration of buoyant uplift and/or dewatering, a design groundwater surface at elev. 18 has been used for design of previous treatment plant structures; this level is considered appropriate for design of currently proposed structures. Resistance to buoyant uplift should be provided by means of adequate weight (e.g. structure weight and soil overburden), pressure relief valves, or other methods.

The site is in a seismically active region and should be considered susceptible to significant ground shaking during the life of the facility. The consistency of the proposed engineered fill and underlying native soil are expected to effectively mitigate potential secondary seismic effects (liquefaction and rapid settlement).

RECOMMENDATIONS

General

Recommendations below are provided based on project descriptions, assumptions and layout as described above. Supplemental study and/or recommendations may be required if changes in project assumptions as stated herein are made. This office anticipates the opportunity to review and comment upon plans and specifications insofar as they rely on the content of this report.

Grading

All site grading should be performed in accordance with the requirements of the Uniform Building Code and recommendations herein. Excavation is expected to be readily achieved using standard heavy-duty grading equipment.

Preparation for grading should include stripping and disposal of all debris and organic material. All existing fill and underlying loose native soil (if any) should be removed to full depth to 5-ft outside the structure limits of the filter complex, control building and alum storage facility. Based on the limited available information, removals are expected to extend to about elev. 23-25. For the alum storage facility, excavation should extend to at least 1½ feet below rough pad grade, for at least 3 feet beyond the base slab footprint in all directions, and at least 2 ft below existing ground surface to enhance uniformity of slab support. The surfaces exposed by stripping and excavation should be reviewed by this office with respect to suitability as fill/structure foundation.

Where engineered fill is to be placed, the approved surface should be scarified to 6-inches depth, moisture conditioned as necessary and compacted to at least 90% relative compaction per ASTM D 1557. Inability to achieve the required compaction may be used as a field criterion to identify areas requiring additional removal or (re)compaction. Excavated soils may then be replaced in thin lifts, moisture conditioned as necessary and compacted to at least 90% relative compaction per ASTM D 1557.

Existing undocumented fill and native soils are expected to be suitable for (re-) use as compacted fill. Any imported fill should be approved by the soils engineer and, in the building area, should have low expansion potential (Expansion Index less than 25). All fill and backfill should be compacted to at least 90% relative compaction per ASTM D 1557 at over-optimum moisture content.

Finished surfaces should be constructed and maintained to provide positive surface drainage away from the structures.

Filter Complex and Pump Station Foundations

Suitable support for the filter complex and pump station is considered available by means of reinforced concrete mat-footings (or structural slab) with grading preparation, excavation and filling per above. The foundations are expected to be within dense native soil or, for shallower portions of the filter complex, within engineered fill.

An allowable (dead plus live) average soil bearing pressure of at least 500 psf may be assigned at base of the mat slabs. Mat widths should be adjusted so that maximum edge stresses at base of slab (due to concentrated wall or line loads) do not exceed 1,000 psf. If foundation load intensity or magnitude exceed these values, this office should be contacted for supplemental evaluation and recommendations.

It is anticipated that either the excavations will be shored or that slopes will be laid back (in accordance with Cal-OSHA requirements). Dry conditions are generally anticipated during dry season but excavations for the pump station and portions of the filter complex might extend below groundwater. Should excavations encounter wet zones or continuous groundwater at foundation level, water should be removed by pumping and any loose or disturbed soils should be treated by over-excavation and replacement with aggregate drain rock (100% passing ¾", 100% retained on No. 4 sieve). The drain rock should be compacted with a vibratory compactor or "hand-wacker."

Such preparation is expected to establish a suitable working pad for personnel and light equipment (e.g. "bobcats"). Should local areas of subgrade exhibit excessive pumping and deflection it may be necessary to re-excavate these areas to below subgrade level and place a thickened aggregate fill lift.

The filter complex and pump station walls are expected to be "rigid" and are not expected to be capable of significant yield under backfill lateral pressures; an "at-rest" lateral earth pressure is therefore considered appropriate for use in design. Buoyant (plus hydrostatic) pressures would apply for those portions of the structures below design groundwater elevation.

For level backfill above design groundwater (elev. 18), wall design may be based on an "at-rest" equivalent fluid pressure of 65 pcf. For undrained granular backfill below design groundwater, an "at-rest" equivalent fluid pressure of 34 pcf plus hydrostatic pressures is considered appropriate. An appropriate surcharge (say, 2-ft minimum) should be applied where backfill is subject to traffic loading.

Inertial soil loads resulting from an earthquake may be estimated on the basis of 50 pcf equivalent fluid pressure with an inverted distribution (i.e. increasing from zero at base of wall to maximum at ground surface). At-rest plus inertial lateral soil loads are not considered capable of displacing fully embedded structures.

Portions of the filter complex and pump station will be below design groundwater level. The pump station should be checked for buoyancy. Conservatively, buoyancy will be resisted by the dead weight of the slab/structure and the weight of soil (125 pcf above elev. 18; 60 pcf below elev. 18) directly over slab extensions beyond wall lines. "Pop-outs" or other methods could also be utilized, if appropriate, for additional safety against structure buoyancy.

Control Building Foundations

Suitable structure support is considered to be available by means of typical reinforced concrete continuous perimeter footings for the control building. An allowable soil bearing pressure of at least 2,000 psf is considered readily available for continuous perimeter footings as proposed at 18-inches wide and penetrating at least 18-inches into engineered fill (below rough pad grade). A one-third increase in the above loads is available for wind and/or seismic loads.

For use in lateral load resistance design of the foundation an allowable passive pressure (equivalent fluid pressure) of 350 pcf and base friction coefficient between the foundation concrete and compacted fill (per above) of 0.4 are considered appropriate. Passive resistance and base friction may be combined.

Slab and footing reinforcement should be stipulated by the design civil/structural engineer. Where slab moisture is a concern due to sensitive floor coverings or other considerations, a capillary break and moisture-proof membrane should be provided.

Utility excavations parallel to "footing lines" should be clear of a 1.5:1 (H:V distance) plane projected downward from base of footings. If structure use/furnishings are moisture sensitive, use of an aggregate capillary break and membrane vapor barrier are recommended as <u>minimum</u> levels of mitigation.

<u>Alum Storage Facility</u>

Uniform tank slab support should be established in engineered fill soil supported on native lower unit materials as identified by this office. A reinforced concrete structural slab, established in an engineered fill prism per above may be assigned a soil bearing pressure of 1000 psf, with 1/3 increase allowable for transient wind or seismic loading. For lateral structural slab support, an allowable passive pressure (equivalent fluid pressure) of 350 pcf and base friction coefficient of 0.40 are considered appropriate. Passive resistance and base friction may be combined.

<u>Structure Settlement</u>

Settlement of dense native soil underlying the filter complex and pump station and of appropriately compacted fill underlying the control building, alum storage facility, and possibly part of the filter complex, is expected to be small. Realized settlement is expected to be due primarily to disrupted soil beneath the structure foundations and slabs, and will depend upon details of construction. Good construction practice to minimize disrupted soil beneath the structure slabs may be critical to performance.

Settlement is expected to occur as load is applied and differential settlement is expected to be less than one-half total maximum realized settlement. If plumbing connections are sensitive to small settlements, pre-loading before connections are made should be considered.

Design for connections between the filter complex beds the attached mudwell and pipe vault should anticipate some stresses due to differential settlement (say, in the range ¼ to ½ inch or less).

The potential for disrupted foundation soil could be reduced by use of 6 to 12 inches of compacted aggregate drain rock beneath the slab and/or increased relative compaction (say, 95%) within 12-18 inches of the foundation/slab base.

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EXP. 3-31-04
GEOTECHNICAL
STATE OF CALIFORNIA

TMS/FPT/ns

Attachments:		"General Conditions"
	Figure 1	"Test Boring Logs" (3 pages)
		"Boring Legend"
	Figure 2	"Laboratory Test Results" (2 pages)
		"Guide Specifications"
	Figure 3	"Location of Field Tests"
	Figure 4	"Test Boring Log No. 3, 1973"

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GENERAL CONDITIONS

The conclusions and recommendations of this study are professional opinion based upon the indicated project criteria and the limited data described herein. It is recognized there is potential for variation in subsurface conditions and that modification of conclusions and recommendations might emerge from further, more detailed study.

This report is intended only for the purpose, site location and project description indicated and assumes design and construction in accordance with applicable codes and standards.

As changes in appropriate standards, site conditions and technical knowledge cannot be adequately predicted, review of recommendations by this office for use after a period of two years is a condition of this report.

A review by this office of any foundation and/or grading plans and specifications or other work product insofar as they rely upon or implement the content of this report, together with the opportunity to make supplemental recommendations as indicated therefrom is considered an integral part of this study and a condition of recommendations.

Subsequently defined construction observation procedures and/or agencies are an element of work that may affect supplementary recommendations.

Should there be significant change in the project or should soils conditions different from those described in this report be encountered during construction, this office should be notified for evaluation and supplemental recommendations as necessary or appropriate.

Opinions and recommendations apply to current site conditions and those reasonably foreseeable for the described development--which includes appropriate operation and maintenance thereof. They cannot apply to site changes occurring, made, or induced, of which this office is not aware and has not had opportunity to evaluate.

The scope of this study specifically excluded sampling and/or testing for, or evaluation of the occurrence and distribution of, hazardous substances. No opinion is intended regarding the presence or distribution of any hazardous substances at this or nearby sites.

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TEST BORING LOG

1P2/500/258

TYPE: 4-Inch Solid Stem Auger

ELEVATION: 30+

BORING No 1

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	MOISTURE (%)	BLOWS/FOOT 350 ft-lb	SAMPLE SIZE (Inches)	SAMPLE No.	DEPTH IN FEET	UNIFIED SOIL CLASS	DESCRIPTION
								CL	Stiff dark brown fine-coarse SANDY fine GRAVELLY CLAY (fill)
		93	13	14	1.4	1			
	M,S,E				Bag	A			
		100	24	41	2.5	2B			
		106	17	41	2.5	2A	5	SM / ML	Dense brown SILTY fine-coarse SAND/SANDY SILT
0.4		111	11	44	1.4	3B			
		107	11	44	1.4	3A	10	GM	Dense brown SILTY SANDY fine GRAVEL
								SC	Compact brown CLAYEY fine-coarse SAND
0.8		107	17	23	1.4	4B			
5.6		96	29	23	1.4	4A	15	CL	Very stiff brown SILTY CLAY to CLAY
3.2		99	26	25	1.4	5	20		
3.6		95	29	21	1.4	6	25		
									12-18-00
3.4		105	24	20	1.4	7	30		
									Boring grout backfilled 12-18-00.
							35		
							40		

THE BORING LOGS SHOW SUBSURFACE CONDITIONS AT THE DATES AND LOCATIONS INDICATED AND IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES

LOGGED BY: T.A.K. | DATE: 12-18-00

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TEST BORING LOG

1P2/500/258

TYPE: 4-Inch Solid Stem Auger

ELEVATION: 30+

BORING No 2

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	MOISTURE (%)	BLOWS/FOOT 350 ft-lb	SAMPLE SIZE (Inches)	SAMPLE No.
		104	13	17	1.4	1
0.5		95	21	10	1.4	2
		109	16	31	2.5	3
0.5		106	16	20	1.4	4
5.7		99	24	28	1.4	5

DEPTH IN FEET	UNIFIED SOIL CLASS	Description
0–7	CL	Stiff dark brown SANDY fine GRAVELLY CLAY (fill?)
7–18	GC	Compact brown CLAYEY fine–coarse SANDY fine GRAVEL
18–21	CL	Very stiff brown CLAY

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40

No free groundwater encountered. Boring grout backfilled 12-18-00.

THE BORING LOGS SHOW SUBSURFACE CONDITIONS AT THE DATES AND LOCATIONS INDICATED AND IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES

LOGGED BY: T.A.K. | DATE: 12-18-00

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CONE PENETROMETER

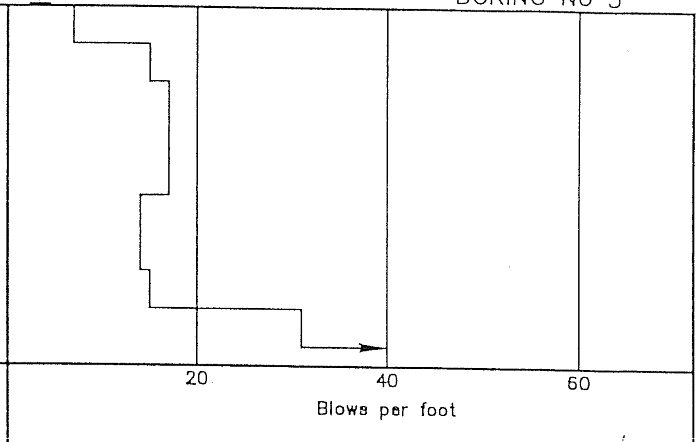
1P2/500/258

TYPE: 2 1/2 Inch Cone Penetrometer

ELEVATION: 28.5±

BORING No 3

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	MOISTURE (%)	BLOWS/FOOT 350 ft-lb	SAMPLE SIZE (Inches)	SAMPLE No.	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS
				7					
				15					
				17					
				17					
				17			5		
				14					
				14					
				15					
				31					
							10		
							15		
							20		
							25		
							30		
							35		
							40		



No free groundwater encountered. Boring grout backfilled 12-18-00.

THE BORING LOGS SHOW SUBSURFACE CONDITIONS AT THE DATES AND LOCATIONS INDICATED AND IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES

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DATE: 12-18-00

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Since 1954

CONE PENETROMETER

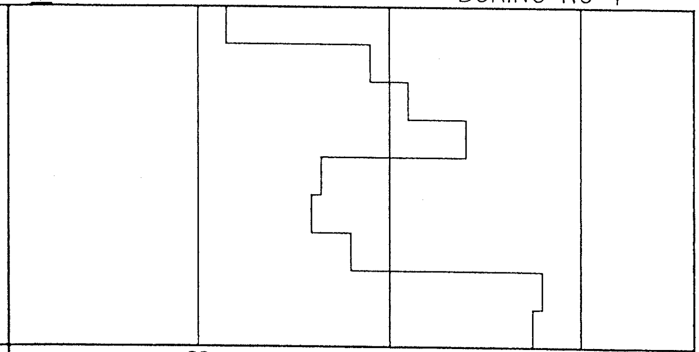
1P2/500/258

TYPE: 2 1/2 Inch Cone Penetrometer

ELEVATION: 28.5±

BORING No 4

UNCONFINED COMPRESSIVE STRENGTH (tsf)	OTHER TESTS	DRY DENSITY (lbs/cu. ft.)	MOISTURE (%)	BLOWS/FOOT 350 ft-lb	SAMPLE SIZE (Inches)	SAMPLE No.	DEPTH IN FEET	MATERIAL SYMBOL	UNIFIED SOIL CLASS
				23					
				38					
				42					
				48					
				33			5		
				32					
				36					
				56					
				55					
							10		
							15		
							20		
							25		
							30		
							35		
							40		



No free groundwater encountered. Boring grout backfilled 12-18-00.

THE BORING LOGS SHOW SUBSURFACE CONDITIONS AT THE DATES AND LOCATIONS INDICATED AND IT IS NOT WARRANTED THAT THEY ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES

LOGGED BY: T.A.K.

DATE: 12-18-00

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LABORATORY TEST RESULTS

EXPANSION INDEX TEST - UBC 18-2 (94)

4" dia x 1" thick remolded specimen, 144 psf surcharge, 24 hr. saturation

Boring/Sample	Dry Density (pcf)	Moisture (%)	Final Moisture (%)	Expansion Index
1/Bag A	108.3	11.0	20.1	43

MAXIMUM DRY DENSITY DETERMINATIONS

(ASTM D1557)

Designation	Depth (ft)	Description	M.D.D. (pcf)	Optimum Moisture (%)
1/Bag A	0-4	Sandy Clay	124½	11.0

SURCHARGE VOLUME CHANGE TESTS

(2 ½" dia x 1" thick specimen, 24-hr saturation at indicated surcharge)

Boring No./ Sample No.	Surcharge (psf)	Initial		Final Moisture (%)	Compression(-) Expansion(+) (%)
		Dry Density (pcf)	Moisture (%)		
1/Bag A	500	115	11.7	16.6	+2.4
1/Bag A	1000	111	11.7	17.4	+0.9
1/Bag A	1500	113	11.7	16.2	+0.7

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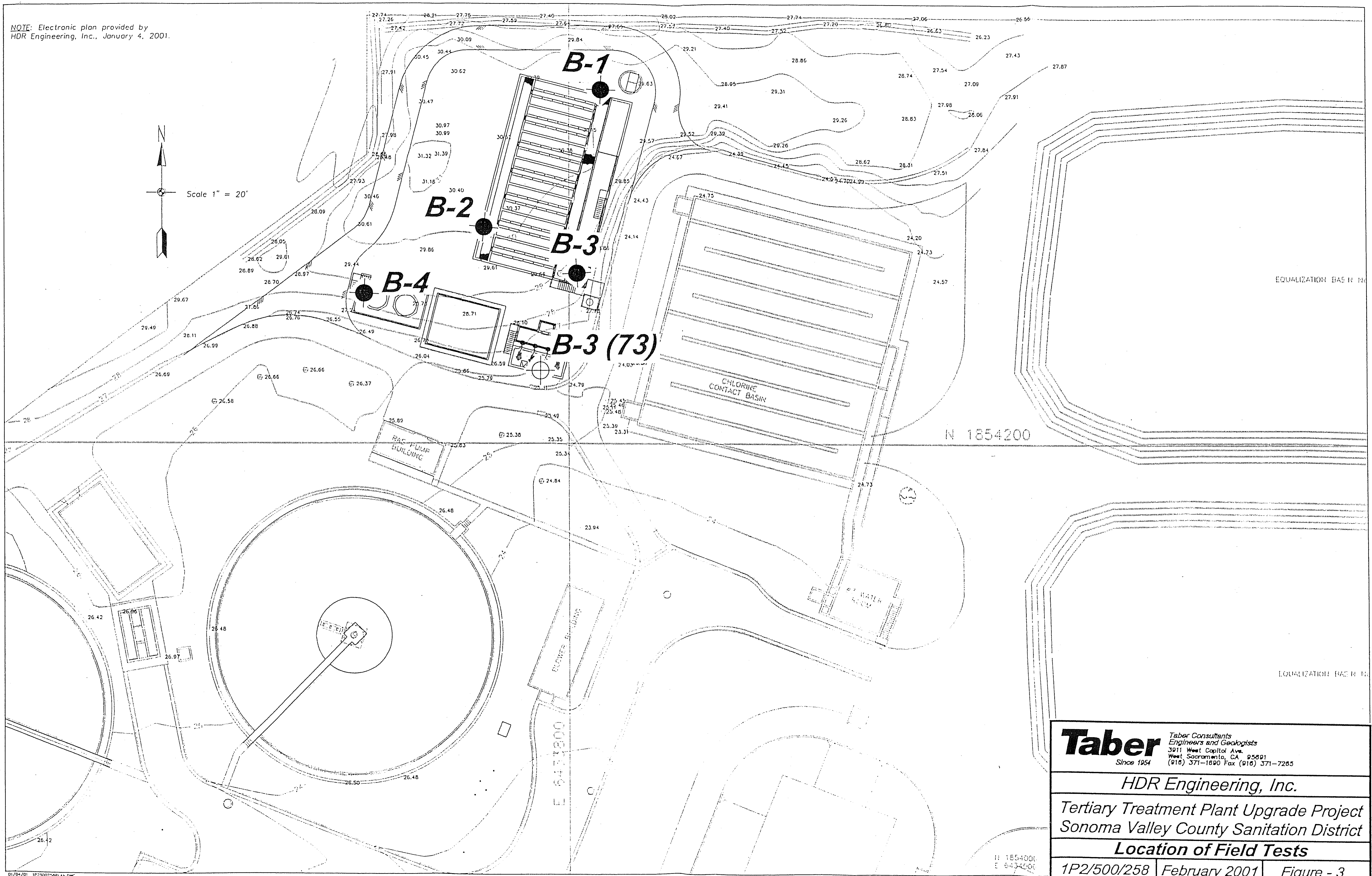
SUMMARY OF DIRECT SHEAR TESTS

Boring/ Sample	Test Condition	Normal Stress (psf)	Peak Values		Ultimate Values	
			Shear Stress (psf)	Displacement (ins)	Shear Stress (psf)	Displacement (ins)
1/Bag A	3-4	500	860	.030	393	.250
1/Bag A	3-4	1000	935	.040	795	.250
1/Bag A	3-4	1500	1533	.060	1365	.250

ALL SAMPLES SHEARED - - SPECIMEN TEST CONDITION AS NOTED - - IN STANDARD CIRCULAR SHEAR BOX UNDER STRAIN CONTROL = 0.025 INS/MIN.

Test Condition Notation

1. Natural moisture, unconsolidated
2. Submerged, unconsolidated
3. Saturated, consolidated at test load
4. Remolded to ±90% relative compaction (ASTM D 1557)



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Tertiary Treatment Plant Upgrade Project
Sonoma Valley County Sanitation District

Location of Field Tests

1P2/500/258	February 2001	Figure - 3

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TEST BORING LOG

TYPE 4" Auger — ELEVATION 24.1 — BORING Nº 3

Unconfined Compressive Strength (tsf)	DRY DENSITY (lbs/cu.ft.)	MOISTURE (%)	BLOWS/FOOT	SAMPLE SIZE (INCHES)	SAMPLE Nº
	98.5	16.3	49	1.4	1
	97.0	16.3	43	1.4	2
	105.0	18.3	71/36	1.4	3
	91.3	28.8	50	2.5	4
1.7	95.8	18.2	58	1.4	5
		25.0	42	1.4	6
	93.3	24.1	36	1.4	7

DEPTH IN FEET	UNIFIED SOIL CLASSIFICATION	Description
0–11.5	SC / GC	Dense brown clayey fine to coarse SAND & GRAVEL
11.5–21	CL / ML	Hard brown silty CLAY with numerous seams of clayey SILT
21–22.5	SC	Dense brown clayey SAND & GRAVEL
22.5–29	CL	Hard brown silty CLAY
29–31	SM / SC	Dense brown silty to clayey fine to medium SAND

Depth scale: 5, 10, 15, 20, 25, 30

MATERIAL SYMBOL

Notes

1. Minor caving of boring walls.
2. Ground water surface:

Date	Time	Depth (feet)
8 May 73	1130	14.4
9 May 73	1215	11.4
10 May 73	1415	10.3
30 May 73	1035	10.5

Logged By T.D.H. — Date 8 May 1973

Job No. 573/55F - 26 June 1973

Figure-4